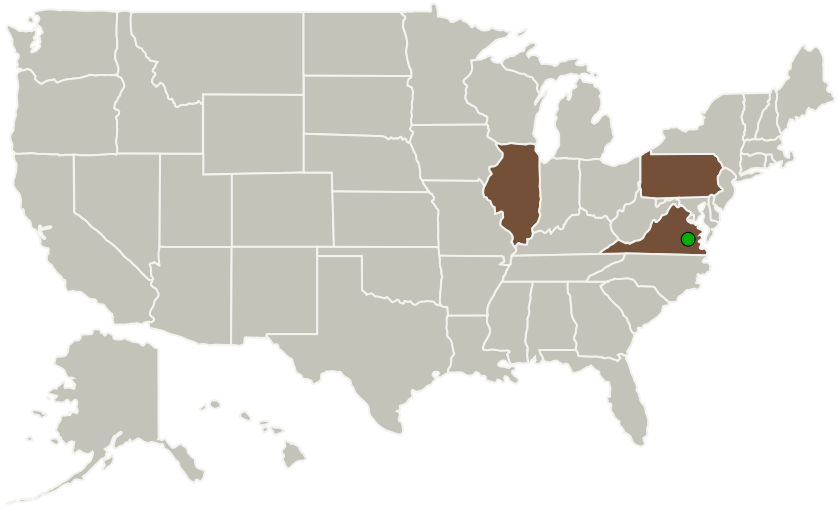
An Automated High Aspect Ratio Mesher for Computational Fluid Dynamics, Phase I

Completed Technology Project (2010 - 2011)

Project Introduction

Computational fluid dynamics (CFD) simulations are routinely used while designing, analyzing, and optimizing air- and spacecraft. An important component of CFD simulations is mesh generation, or discretization into polygonal or polyhedral cells, of the domain being analyzed. The overall computational cost and accuracy of simulations depend heavily on mesh quality ⬲ the size, shape, and structure of the cells. Another important aspect of CFD simulation is that solutions are achieved iteratively, with each subsequent pass decreasing error and increasing solution accuracy. Grid adaption uses output from the last simulation to improve the mesh for the next. FUN3D is a CFD simulator developed at NASA that requires both a tight integration with mesh generation software for grid adaption and the generation of high aspect ratio cells (i.e. 10,000:1) to accurately capture dynamics around boundary layers. Current meshing methods use the well known advancing front or Delaunay algorithms, and the user must often perform multiple manual inputs and interactions to generate a mesh of sufficient quality. Ideally, a meshing module would subdivide complex designs and perform grid adaption automatically, with little or no human intervention. The proposed innovation is the development of a very high aspect ratio mesher that demonstrates a significant improvement over current techniques as measured by the time and effort necessary for FUN3D users to solve CFD problems.

Primary U.S. Work Locations and Key Partners



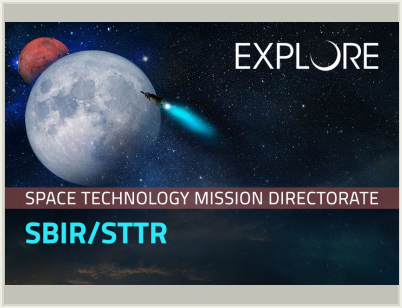


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Table of Contents

Small Business Innovation Research/Small Business Tech Transfer

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Organizations Performing Work	Role	Type	Location
Ciespace Corporation	Lead Organization	Industry	Oak Brook, Illinois
Carnegie Mellon University	Supporting Organization	Academia	Pittsburgh, Pennsylvania
Langley Research Center(LaRC)	Supporting Organization	NASA Center	Hampton, Virginia

Primary U.S. Work Locations	
Illinois	Pennsylvania
Virginia	

Project Transitions

January 2010: Project Start

January 2011: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/140152)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Ciespace Corporation

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

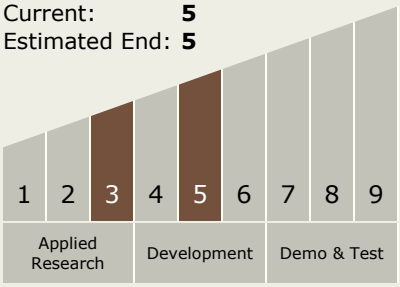
Carlos Torrez

Principal Investigator:

Kenji Shimada

Technology Maturity (TRL)

Start: **3**
Current: **5**
Estimated End: **5**



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Technology Areas

Primary:

- TX15 Flight Vehicle Systems
  - TX15.1 Aerosciences
    - TX15.1.7 Computational Fluid Dynamics (CFD) Technologies

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System